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DIFFUSION REFLECTING FILM
[Kakusan hansha firumu]

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[Claim(s)] /2*

[Claim 1] A diffusion reflecting film characterized by forming a metal vapor deposition layer 2 on the reflecting side of the face of a plastic film base 1 for reflective use containing a white pigment and having a total optical transmissivity of at most 50%, and further forming a corrosion-preventing layer 3 on said metal vapor deposition layer 2.

[Claim 2] The diffusion reflecting film of Claim 1 wherein the plastic film base 1 containing a white pigment contains at least one kind of white pigment, which is selected from among titanium oxide, barium sulfide, magnesium sulfide, silicon oxide, magnesium carbonate, and calcium carbonate, kneaded into a plastic, or it possesses said pigment on the film surface by coating it thereon or contains it in a state in which it is provided along with each of the aforesaid constituents.

[Claim 3] The diffusion reflecting film of Claim 1 wherein the metal vapor deposition layer 2 is at least one kind of film selected from among silver, an alloy of silver and another metal, and a laminate of silver and another metal.

[Detailed Explanation of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a diffusion reflecting film for liquid crystal display use, and in

*Claim and paragraph numbers correspond to those in the foreign text.

further detail, a diffusion reflecting film for a paper white-colored liquid crystal display high in diffusion reflectance and outstanding in non-directivity. The diffusion reflecting film of the present invention is suitable for use in conventional types of reflection-type liquid crystal displays, such as STN and TFT types, reflection-type liquid crystal displays of polarization plate displays, etc.

[0002]

[Prior Art] Reflection films obtained by vapor depositing aluminum or silver on a polyethylene terephthalate film in which a white pigment has been kneaded in or a matted polyethylene terephthalate film; silver vapor-deposited film; aluminum vapor-deposited film; aluminum foil; aluminum sheet; stainless steel sheet; and the like have been used for reflective films.

[0003]

[Problems to be Solved by the Invention] However, there are drawbacks with such a conventional polyethylene terephthalate film in which a white pigment has been kneaded in because the diffusion reflectance is low and the paper white property is poor. The term "paper white property" uses the brightness of barium sulfate used in standard white sheets as the standard. This brightness is required for liquid crystal display use because the higher the contrast between liquid crystal display screens the better, so that the screens are easily viewed. In addition, reflective films obtained by vapor depositing aluminum or silver on a matted polyethylene

terephthalate film (using the vapor deposition face and the reflection face), aluminum films, aluminum sheets, stainless steel sheets, and the like have drawbacks, such as directivity due to the metallic appearance, and a poor paper white property.

[0004]

[Means for Solving the Problems] The present invention solved the aforesaid problems of the conventional products. That is, it is a diffusion reflecting film characterized by forming a metal vapor deposition layer 2 on the reflecting side of the face of a plastic film base 1 for reflective use containing a white pigment and having a total optical transmissivity of at most 50%, and further forming a corrosion-preventing layer 3 on said metal vapor deposition layer 2, and moreover, it is the aforesaid diffusion reflecting film wherein the plastic film base 1 containing a white pigment contains at least one kind of white pigment, which is selected from among titanium oxide, barium sulfide, magnesium sulfide, silicon oxide, magnesium carbonate, and calcium carbonate, kneaded into a plastic, or it possesses said pigment on the film surface by coating it thereon or contains it in a state in which it is provided along with each of the aforesaid constituents, and further, it is the aforesaid diffusion reflecting film wherein the metal vapor deposition layer 2 is at least one kind of film selected from among silver, an alloy of silver and another metal, and a laminate of silver and another metal.

[0004] Silver containing a white pigment is vapor deposited on the reflection side of the face of a plastic film, which has a total optical transmissivity of 50% or less, used for reflection, whereby the film is imparted with coverage, while the silver is the highly reflective layer. The diffusion reflectance is high, and at the same time, the paper white color is emphasized even more. Furthermore, the light reflected by the silver vapor deposition layer is light which is multiply reflected by the white pigment, has abundant diffusibility, and little directivity. Furthermore, the silver vapor deposition layer is readily corroded; hence, by providing a corrosion-preventing layer it is provided with durability, thus solving all the problems of conventional diffusion reflecting films.

[0005]

[Embodiments of the Invention] The configuration of the diffusion reflecting film of the present invention will be described in detail based on (Figure 1). As long as it is a plastic film containing white pigment and the total optical transmissivity is at most 50%, it can be used for the base 1 adopted in the diffusion reflecting film of the present invention. Furthermore, even a white plastic film to which a UV absorber, white colorant, and antistatic agent has been added can be used to improve performance. Although the preferred range of the total optical transmissivity is at most 50%, it is more preferably at most 20%, and even more preferably, at most 15%. The lower limit is not restricted in particular. Although not

limited in particular, an acryl film, polycarbonate film, polyallylate film, polyethylene terephthalate film, polyethylene naphthalate film, fluorine film, and the like are preferable for the base resin of the plastic film.

[0006] In addition, white pigments, such as titanium oxide, barium sulfide, magnesium sulfide, silicon oxide, magnesium carbonate and calcium carbonate, are preferable for the white pigment contained in the base (1). Although the particle size is not limited in particular, preferably it is at most 50 μm. It is not preferable that the particle size be larger than 50 μm because the white pigment becomes a hindrance while kneading it into the plastic film and coating it on the surface of the plastic film. The white pigment is kneaded into the plastic film, it is coated on the surface of the plastic film, or it is kneaded into the plastic film and then coated thereon. The amount thereof added is preferably an amount added to attain a total optical transmissivity of at most 50%. It is not preferable that the total optical transmissivity be 50% or more because there is a metallic gloss and the directivity and paper white color are weak. It is more preferable that these bases 1 be obtained by molding plastics containing the aforesaid white pigments into films. Further improvement in the lightweightedness and brightness can be realized by further containing air and other polymers in the plastic.

[0007] The thickness of the base 1 is not limited in particular, but normally a range of from 12 to 300 μm is preferable. It is not preferable that the thickness be less than 12 μm because the strength is insufficient and the workability worsens, or on the other hand, if the thickness exceeds 300 μm because not only is the strength too high or the workability worsened, but the cost increases, and thus not economically advantageous or practical.

[0008] The metal vapor deposition layer 2 used in the diffusion reflecting film of the present invention is formed in a film-forming method, such as a vacuum vapor deposition method, sputtering method, or ion plating method. Silver, an alloy of silver and another metal, and a laminate of silver and another metal are preferable for the metal vapor deposition layer. The thickness of the metal vapor deposition layer 2 is not limited in particular, but a range of from 10 nm to 200 nm normally is suitably selected. It is not preferable that the thickness be less than 10 nm because no reflection effects are recognized, or on the other hand, if it exceeds 200 nm because not only is no further improvement in the reflection effects recognized, and the internal stress of the metal vapor deposition layer tends to increase and the adhesive strength with the base tends to decrease, but the amount of silver used also increases; hence, it is economically worse off.

[0009] Although the corrosion-preventing layer 3 used in the diffusion reflecting film of the present invention is not limited in

particular, paints comprising any of, e.g., thermoplastic resins, thermosetting resins, electron beam-curable resins, UV-curable resins, and the like can be used therefor. For example, resin paints comprising amino-based resins, aminoalkyd-based resins, acrylic resins, styrene-based resins, acryl-styrene copolymers, urea-melamine-based resins, epoxy-based resins, fluorine-based resins, polycarbonates, nitro-cellulose, cellulose acetate, alkyd-based resins, polyester resins, polyamide-based resins, and the like singly, or as mixtures can be employed. The aforesaid corrosion-preventing layer 3 is formed by coating a paint obtained by diluting with a solvent the resin of the aforesaid corrosion-preventing layer on the entire surface of the metal vapor deposition layer 2 side of the base obtained by forming the aforesaid metal vapor deposition layer 2 in the usual coating method, such as a gravure coating method, roll coating method, and dip coating method, and drying this (curing in the case of a curable resin). The thickness of the corrosion-preventing layer 3 is not limited in particular, but normally it is suitably selected from a range of 0.5 to 5 μm. It is not preferable that the thickness be less than 0.5 μm because the surfaces of the aforesaid base and the vapor deposition layer cannot be covered uniformly, no effects from forming a corrosion-preventing layer can be manifested sufficiently, and there is no value in forming a corrosion-preventing layer, or on the other hand, that the thickness exceed 5 μm because there is no major difference in the effects of

the corrosion-preventing layer, while the drying rate of the corrosion-preventing layer is slow, and thus is inefficient.

[0010] The diffusion reflecting film obtained accordingly is paper white in color, with a high diffusion reflectance and outstanding non-directivity because the metal vapor deposition layer 2 is formed on the surface opposite the face of the base 1 used for reflection, and further, the corrosion-preventing layer 3 is formed on the metal vapor deposition layer 2. Therefore, the diffusion reflecting film can be used in diffusion reflecting films for liquid crystal displays, etc. The diffusion reflecting film will now be described in detail by citing practical examples, but we are not to be limited thereby.

[0011]

[Practical Examples]

**Practical Example 1

Silver was vacuum vapor deposited on the opposite side used for reflection of a 100 μm thick polyethylene terephthalate film (trade name: Lumilar X-42, made by Toray Industries, Inc.; with silicon oxide kneaded in; total optical transmissivity 46%) to form an 80 nm thick metal vapor deposition layer, a melamine-epoxy resin paint was subsequently coated on the entire surface thereof and dried to form a 1.5 μm thick corrosion-preventing layer, and the diffusion reflecting film of the present invention was obtained.

**Practical Example 2

Silver was sputtered on the opposite side used for reflection of a 50 μm thick polyethylene terephthalate film (trade name: Teijin Tetron Film U2, made by Teijin Ltd.; with titanium oxide kneaded in; total optical transmissivity 23%) to form an 80 nm thick metal vapor deposition layer, an acryl resin was subsequently coated on the entire surface thereof and dried to form a 1.5 μm thick corrosion-preventing layer, and the diffusion reflecting film of the present invention was obtained.

[0012] **Practical Example 3

Silver was sputtered on the opposite side used for reflection of a 38 μm thick polyethylene terephthalate film (trade name: Diafoil W-400, made by Diafoil K.K.; with titanium oxide kneaded in; total optical transmissivity 14%) to form an 80 nm thick metal vapor deposition layer, an acryl resin paint was subsequently coated on the entire surface thereof and dried, to form a 1.5 μm thick corrosion-preventing layer, and the diffusion reflecting film of the present invention was obtained.

**Practical Example 4

A liquid paint wherein titanium oxide was kneaded into an acryl resin paint was coated on the entire surface to a 5 μm thickness and dried, silver was vacuum vapor deposited on the opposite side that a 55 μm thick coating polyethylene terephthalate film having a total optical transmissivity of 20% was coated on to form an 80 nm thick metal vapor deposition layer, a melamine-epoxy resin paint was

subsequently coated on the entire surface thereof and dried to form a 1.5 μm thick corrosion-preventing layer, and the diffusion reflecting film of the present invention was obtained.

[0013] **Comparative Example 1

A conventional diffusion reflecting film was obtained from a 100 μm thick polyethylene terephthalate film (trade name: Lumilar X-42, made by Toray Industries, Inc.; with silicon oxide kneaded in; total optical transmissivity 46%).

**Comparative Example 2

A conventional diffusion reflecting film was obtained from a 50 μm thick polyethylene terephthalate film (trade name: Teijin Tetron Film U2, made by Teijin Ltd.; with titanium oxide kneaded in; total optical transmissivity 23%).

[0014] **Comparative Example 3

A conventional diffusion reflecting film was obtained from a 38 μm thick polyethylene terephthalate film (trade name: Diafoil W-400, made by Diafoil K.K.; with titanium oxide kneaded in; total optical transmissivity 14%).

**Comparative Example 4

A conventional diffusion reflecting film was obtained coated with a 55 μm thick polyethylene terephthalate film having a 20% total optical transmissivity obtained by coating a liquid paint wherein titanium oxide was kneaded into an acryl resin paint on the entire surface to a thickness of 5 μm and dried.

[0015] The results upon examining the diffusion reflectance, brightness and directivity of the films of the practical examples and comparative examples obtained accordingly are shown in Table 1.

<Method for Evaluating Diffusion Reflectance> The diffusion reflectance was examined by measuring it using a spectrophotometer (UV-3100PC, made by Shimadzu Corp.) and reading it at a wavelength of 550 nm.

<Method for Evaluating Directivity> The directivity was examined by reading the absolute reflectances (550 nm) at incident angles of 5°, 12° and 45°using a spectrophotometer (UV-3100PC, made by Shimadzu Corp.).

<Method for Evaluating Brightness> The brightness was examined by measuring the CIEs L*, a* and b* of the diffusion reflection light using a spectrophotometer (UV-3100PC, made by Shimadzu Corp.).

[0016]

[Table 1]

	拡散反射率 (%)	指向性 (%)			白色度		
		5°	12°	45°	L*	a*	b*
実施例1	97.14	3.30	4.42	3.50	97.88	-0.62	0.70
比較例1	50.43	1.66	4.12	2.34	76.33	-0.78	-4.19
実施例2	94.58	3.35	4.46	3.55	97.87	-0.39	0.59
比較例2	80.22	2.16	4.17	2.45	91.78	-0.81	-3.42
実施例3	96.11	3.36	4.58	3.40	98.08	-0.35	0.61
比較例3	88.34	2.20	4.44	2.40	95.30	-0.62	-1.81
実施例4	95.31	3.20	4.35	3.32	97.51	-0.24	0.55
比較例4	82.35	1.98	4.25	2.19	92.11	-0.85	-4.14

Key:

	Diffusion Reflectance (%)	Directivity (%)			Brightness		
Practical Example 1							
Comparative Example 1							
Practical Example 2							
Comparative Example 2							
Practical Example 3							
Comparative Example 3							
Practical Example 4							
Comparative Example 4							

It is seen from Table 1 that the diffusion reflectances of the practical examples are improved over those of the comparative examples, and that the paper white color is far superior.

[0017]

[Advantages of the Invention] By forming a metal vapor deposition layer on the opposite side of a plastic film base having a 50% total optical transmissivity and containing a white pigment, and further forming a corrosion-preventing layer thereon, a diffusion reflecting film for paper white liquid crystal display use that was practical, having a high diffusion reflectance, and outstanding non-directivity was obtained. By defining the total optical transmissivity of the plastic film base to at most 50%, the advantages of the present invention were manifested, but the total optical transmissivity is more preferably at most 15%. It has been unexpectedly found that the metal vapor deposition layer had advantages even with a total optical transmissivity of 0% (in a method of measurement according to the present invention).

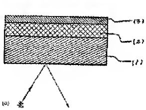
[Brief Description of the Drawings]

[Figure 1] A drawing showing an outline of the configuration of the present invention.

[Explanation of the Reference Numerals]

1: plastic base; 2: metal vapor deposition layer; 3: corrosion-preventing layer

[Figure 1]



Key: (a) light